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ABSTRACT

Designed to aid local educators as they formulate plans to use distance learning as a strategy for providing effective educational experiences, this resource guide provides an introduction to telecommunication-based distance education technologies and guidelines for their implementation. The first of six sections discusses the rationale for distance learning and lessons learned from educators' experiences with telecommunications. The second section discusses instructional television, noting that it is a distance learning tool that is already largely available to schools. Sections three through five discuss satellite broadcasting of live or taped instruction, Instructional Television Fixed Service (ITFS) delivery of live or taped materials, and audio-teleconferencing. Section summaries highlight the advantages and disadvantages of the different technologies with respect to the issues of interaction, flexibility, and programs, and applications are illustrated by descriptions of sample programs in Alaska, Florida, Kentucky, Minnesota, New York, North Carolina, Oklahoma, South Carolina, Texas, Utah, and Wisconsin. The final section suggests a strategy for implementation of these technologies. Reference lists are provided at the end of each section. (RP)

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TELECOMMUNICATIONS-BASED DISTANCE LEARNING

A GUIDE for LOCAL EDUCATORS

Prepared by Sally L. Bond

Spring 1987

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TELECOMMUNICATIONS-BASED DISTANCE LEARNING

A Guide for Local Educators

Executive Summary

Prepared by Sally L. Bond

Telecommunications-based distance learning is a concept whose time has come. Much literature is available on distance learning, and many practitioners have experience with it. However, these resources are widely scattered and not easy to pull together. This guide represents an effort by the Southeastern Educational Improvement Laboratory (SEIL) to draw together such information. The guide should aid local educators as they formulate plans to utilize distance education as a strategy for providing effective educational experiences.

Distance learning, learning that takes place at a distance from an instructor or source of instruction, is associated with a variety of options. Currently, most distance learning is accomplished through instructional television, satellite broadcasting of live or taped instruction, Instructional Television Fixed Service (ITFS) delivery of live or taped instruction, and audio-teleconferencing. These are explored in this report.

Why Distance Learning?

In the last ten to fifteen years, distance learning has come of age in the wake of myriad developments in both education and in the telecommunications industry...

Educating the Work Force: Reform strategies related to economic development include raising standards and increasing requirements for high school graduation or college admission.

Pupil and Teacher Shortages: Rural and small schools cannot afford teachers for low enrollment classes. Teacher shortages in math, science, and foreign languages also make it difficult for schools to offer these courses.

Equity in Education: Equal educational opportunities must be made available to all students. Increased standards or admission requirements effectively exclude students who live in sparsely populated rural areas that can neither afford nor attract teachers to provide the requisite instruction.

Advances in Technology: Innovations and improvements in technology now make it possible to provide instruction over long distances. Once only available to large corporations, these technologies are becoming more affordable and more flexible for use in education.

Lessons Learned

Educators already have considerable experience with distance learning technologies. This experience has produced some important lessons.

Interaction: Audio and video interaction are important factors in the success of a distance learning program for student learning.

Flexibility: Teachers and students should have adequate access to the technology and should receive proper training to use it effectively.

Programming: Most important of all, educational technology is only as effective as the programming it presents. Excellent programming justifies the expense of the technology.

Before considering any application of technology, school districts should clearly establish their needs for distance education. These needs should drive the pursuit of distance learning technologies, not the reverse.

In the Beginning ... Instructional Television

Instructional television (ITV) is not a new distance learning technology. It is widely available to schools. Some of the more advanced technologies, like satellites or instructional television fixed service, can be used to deliver ITV in more efficient or flexible ways. Nevertheless, ITV broadcast on open-circuit television may be adequate for some schools' needs. Where this resource is already available, it should be used to its greatest potential before investment is made in other technologies.

- ITV is not an interactive technology. However, active viewing strategies can be developed to make ITV more stimulating.
- Fixed broadcast schedules limit the flexibility of ITV. This problem is solved by taping programs on videocassette recorders at the time they are broadcast. Tapes can then be played back at teachers' convenience.
- Primary schools have the broadest needs for ITV and those needs have been served well. The market for secondary school programming is expected to grow in the next five to ten years.

Extending Reach ... Satellite Broadcasting

Satellites are advantageous for transmitting instruction over broad areas. As long as programming is transmitted to an adequate number of people, satellite broadcasting can be cost-effective.

Instruction delivered by satellite can either be pre-programmed, as in the case of ITV, or live. Satellites are used to distribute ITV more efficiently than mail. Otherwise, satellite transmission does not alter the interactive capability, flexibility, or programming aspects already discussed above with respect to ITV.

- Only audio interaction is possible during a live satellite telecourse. Video interaction is not possible. Students in remote sites can see the instructor, but the instructor cannot see them. On-site coordinators can be used to maintain control in the remote classrooms, but it is difficult for the teacher to develop more personal ties with remote students.
- Satellite technology is flexible insofar as it can be adapted for other uses besides classroom instruction. Live teleconferences by satellite make it possible to bring people together across great distances without the time and expense of travel. Additional uses of the technology help to defray its cost. Even so, scheduling live television can be difficult as the number of receiving sites increases.
- Satellite programs are being developed to provide instruction in subjects that are most difficult to staff, but problems related to accreditation arise when telecourses are broadcast across state lines. Courses cannot be tailored to meet the special needs of every state that subscribes to them.

Increasing Flexibility ... ITFS

Instructional Television Fixed Service (ITFS) refers to an area on the electromagnetic broadcast spectrum that is reserved by the FCC for the transmission of instructional and cultural material. The FCC allocates ITFS channels in blocks of four channels each. The transmission range of this low-frequency microwave signal is approximately 15 to 20 miles from point to point. ITFS has been available for many years. Only recently has the cost of operating an ITFS system become reasonable for school systems.

As with satellite broadcasting, ITFS can provide either live or taped programs. ITFS offers greater flexibility in the local delivery of ITV because of the multiple channels available in each system. Special programming requests are also more easily accommodated on an ITFS system. ITFS transmission does not alter the interactive capability or programming aspects already discussed with respect to ITV.

- An audio response channel enables two-way audio interaction when teaching live over an ITFS system. Two-way video interaction is possible by sending either a full motion video signal (e.g., low-power television or microwave) or still images (e.g., freeze-frame television) of remote classrooms back to the instructor.
- ITFS offers greater flexibility in the local delivery of ITV because of the multiple channels available in each system. Special programming requests are more easily accomodated when several programs can be offered at the same time. The technology is also adaptable for use in staff development or administrative conferences.
- ITFS is a closed-circuit system. Courses are designed to meet the special needs of the schools that have access to the system. At the same time, participating schools or school districts contribute resources in such a way as to expand the pool of resources available to all.

Containing Costs ... Audio-Teleconferencing

Most live, interactive distance learning takes place via telephone audio-teleconferencing. Low cost and the limited expertise required to operate the technology account for its popularity among distance educators. Participants are easily connected through a teleconference bridge.

- Audio-conferences do not use two-way full motion video. Audio interaction alone cannot illustrate visual concepts, so various devices are used to augment the medium. These devices include electronic blackboards, freeze-frame television technology, and facsimile machines.
- Any site that is equipped with a telephone can participate in an audio-teleconference. The technology is flexible enough to be used for either enrichment programming or for regular classroom instruction.
- Some educators feel that audio interaction alone is boring for students. Others insist that the technology is not being used creatively if students are bored. In either case, it is important

to involve students by continually asking questions or soliciting comments from them. Electronic blackboard and freeze-frame images can add to the interest a lesson has by giving students something to see, but they do not add greatly to the cost of an audio-teleconference.

Getting Started

Schools with scarce resources should heed the experience of educators who have already begun to work out some of the problems of providing instruction through distance learning. A suggested strategy for getting started includes:

- Clearly define needs for curriculum expansion. Establish whether or not these needs are peculiar to local schools, districts, or regions. Or perhaps these needs characterize the entire state. Be aware of opportunities to share resources with those who have similar needs.

- Before investing in more technology, assess the distance learning potential of technology that is already available -- instructional television, for example.

- Utilize educators' experience, the literature, and other resources. Explore the technology that seems most likely to address the needs specified in your school(s).

- Identify teachers who are willing and able to teach via telecommunications. Teachers do not necessarily have to adopt different teaching styles to accomodate distance media. Instead, they should capitalize on strategies that make them effective in their regular classroom settings. The most important skill for the distant teacher to cultivate is the ability to encourage students' participation.

- Assemble the necessary expertise ...
  Legal: to provide assistance if filing an FCC license application for technologies that operate within regulated spectrum space.
  Engineering: to design a system configuration for the locations in question and provide an estimate of the cost.
  Financial: to research state funding formulas, grant resources available for distance learning projects, or cooperative ventures with business and industry.
  Instructional Design: to match curriculum objectives with the medium selected for delivery of distance education.
  Teacher Training: to provide distant teachers with adequate preparation to teach effectively using the technology, especially to handle contingencies of the technology.

- If you do not have the necessary experts on staff, then secure the services of a consultant with varied experience in the field of telecommunications.

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And finally, this guide could not have been prepared without the patient assistance of numerous experienced educators. They have provided the most valuable resources for this guide.

Section I. Introduction

Telecommunications-based distance learning is a concept whose time has come. Much literature is available on distance learning, and many practitioners have experience with it. However, these resources are widely scattered and not easy to pull together. This guide represents an effort by the Southeastern Educational Improvement Laboratory (SEIL) to draw together such information. The guide should aid local educators as they formulate plans to utilize distance learning as a strategy for providing effective educational experiences.

Distance learning refers to learning that takes place at a distance from an instructor or source of instruction. The term is associated with a variety of options for delivering instruction to students who might otherwise not receive it. Supervised correspondence study is a familiar distance learning option. Now, it can be augmented by telecommunications, like instructional videos or audio-teleconferencing (Barker, 1985).

Examples of telecommunications-based distance learning options include: instructional television on regular VHF/UHF television channels, satellite broadcasting of live or taped programs, Instructional Television Fixed Service (ITFS) delivery of live or taped programs, and audio-teleconferencing. These are explored in this report. Each makes possible the delivery of instruction to distant learners.

Why Distance Learning?

In the last ten to fifteen years, telecommunications-based distance education has become a viable means of providing instruction. Developments in both education and in the telecommunications industry account for this...

Educating the Work Force: Reform strategies related to economic development include plans to attract new businesses and industries. To accomplish this, states must assure investors of a capable work force. Therefore, states are concerned that their students master more than the basic skills. Toward this end, higher standards and increased requirements for high school graduation or college admission are being legislated.

Pupil and Teacher Shortages: Limited enrollments in advanced math and science courses and advanced placement courses in general make it difficult to justify the allocation of funds for instructors. At the same time, teacher shortages are growing in subjects like math, science, and foreign languages. Teachers are not available in some areas, regardless of enrollment, and those who are already employed are often stretched too thin to teach these courses.

Equity in Education: These concerns dovetail with the larger problem of providing equity in our schools. Equal educational opportunities must be made available to all students. Increased high school graduation or college admission requirements effectively exclude students who live in sparsely populated rural areas that can neither afford nor attract teachers to provide the requisite instruction. School districts that cannot provide the necessary courses may have to consolidate and sacrifice their local identities.

These developments have encouraged educators to look to telecommunications for solutions to the problems raised. Meanwhile, advances in the

telecommunications industry have increasingly made telecommunications-based distance education more affordable. In addition, more numerous and more flexible options are now available to meet the changing needs of education. Even more salient is the experience already garnered from applications of the technology. This experience is demonstrating that telecommunications-based distance education offers a reasonable and viable means of providing instruction when traditional classroom teachers are not available.

Lessons Learned

Educators' experience with telecommunications has already produced some important lessons. These lessons emerge from both the relevant literature in this area and discussions with educational practitioners who are applying telecommunications to education in new ways.

Interaction: Interaction is generally agreed to be a good technique in any classroom context for stimulating the interest of the learner and reinforcing what is learned. The more the learner is able to react to and participate in the instruction taking place, the more likely it is that the instruction will aid student learning. Progress in the development of telecommunications, both audio and video, is permitting such interactions to take place through distance education programs.

Flexibility: In order for teachers to make use of technology and use it effectively, it must be accessible to them. This means that technology is both available when needed and easy to use. Among other things, an adequate supply of equipment, proper training of teachers to use the technology, and flexible scheduling of distance education programs can facilitate the effective use of telecommunications for instruction.

Flexibility also refers to the technology itself. Being versatile enough for purposes besides elementary and secondary instruction makes technology more cost-effective. For instance, telecommunications also enable distant educators to participate in staff development activities or administrative teleconferences.

Programs: Most important of all, the technology is only as effective as the programs or materials that it presents. Telecourses should manifest carefully designed curricula, and quality enrichment materials should be wisely incorporated into existing curricula. Transmission or distribution devices, like the ones discussed later in this report, are in a sense ancillary to the programs that they deliver. In other words, the hardware (e.g., open-circuit television or cable, satellites, ITFS, or audio-teleconference networks) is useless if the software (e.g., instructional television, live telecourses, or audio-teleconferences) is poorly designed and executed. What the technologies themselves offer are differing degrees or modes of interaction and flexibility. Excellent programs justify investment in these technologies.

Before considering any application of technology, school systems should establish curriculum needs. These needs should drive the pursuit of distance learning technologies, not the reverse. Give some thought as well to desired standards for interaction, flexibility, and programs -- then go exploring! This report has been prepared with these themes in mind. It is intended to give educators a sense of what is possible for students and schools through telecommunications and distance education.

This guide is by no means an exhaustive study of the telecommunications that can be used to deliver instruction to distant learners. Fiber optics,

computer networks, and interactive videodiscs are notable examples of promising distance education technologies that are excluded from this report. The scope of this report is limited to the kinds of technologies with which educators already have the most experience. School districts with scarce resources are especially urged to capitalize on this experience. The technologies discussed here were selected to give the reader a sense of the range of possibilities that technology can create for education. The reader will also be exposed to issues and concepts that are common to all applications of technology to distance education.

Overview

The following sections present several distance education technologies. Each section is organized to give the reader a preliminary understanding of a particular distance education technology. Section II discusses instructional television, a distance learning tool that is already largely available to schools. Sections III through V discuss satellite broadcasting, Instructional Television Fixed Service, and audio-teleconferencing respectively. These latter three sections include brief descriptions of sample programs illustrating applications of the technology to distance education. Section summaries highlight the advantages and disadvantages of the different technologies with respect to issues of interaction, flexibility, and programs. The final section suggests a strategy for implementing telecommunications-based distance learning programs.

Distance Learning Resources

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Hudson, Heather E. and Boyd, Charles H. Distance Learning: A Review for Educators. Austin, TX: Southwest Educational Development Laboratory, [March 1984]. (To obtain, send $5.00 plus 15% shipping and handling to SEDL, Publications Office, 211 East 7th Street, Austin, TX 78701; refer to SEDL document 300007, ERIC ED 246872)

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Conversations with:

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Reta Richardson, Chief Supervisor for Resource Development, South Carolina State Department of Education (Columbia, SC)

John Speckien, Director of Technical Education, Boulder Valley Schools (Boulder, CO)

Section II. In the Beginning ... Instructional Television

The first attempts at telecommunications-based distance education began in 1953 after the Federal Communications Commission (FCC) reserved 242 channels for noncommercial broadcasting of educational television (Carnegie Commission on the Future of Public Broadcasting, 1979). In the intervening years, a distinction has evolved between educational television (ETV) and instructional television (ITV). Today, ETV refers generically to public television that is in the domain of the Public Broadcasting Service (PBS) of the Corporation for Public Broadcasting (CPB). Public television is responsible for noncommercial broadcasting of general audience programming that typically airs at night and on weekends.

For the most part, instructional television is broadcast over the open-circuit channels operated by PBS-affiliated public television stations. ITV refers to programs that are developed for use in conjunction with formalized classroom instruction. Teacher guides and other supporting materials often accompany these programs. Programming generally airs during the daytime hours and is usually managed or influenced in some way by state departments of education.

Instructional television then is viewed as an educational tool. It is delivered through a television set and is a form of distance education. ITV programs are usually transmitted via regular open-circuit television or cable. Two other means of transmitting ITV programs, satellite broadcasting and Instructional Television Fixed Service, are discussed in Sections IV and V of this guide.

The major advantage of ITV has always been its ability to bring people, places, and experiences into the classroom to students who would otherwise not be exposed to them. Unfortunately, television technology was in use long before program and production issues received careful attention. Poor production and static formats once earned ITV the reputation of "talking head." Inadequate or ineffective programs influenced teachers' limited application of this medium in the classroom. Today, the ITV industry is making a concerted effort to improve ITV programs.

Interaction and ITV

Because it is not an interactive medium, ITV has limitations as an instructional tool. Recently, it has been criticized for being a kind of passive "babysitter" in the classroom. This problem is the result of inappropriate or poorly integrated applications of ITV to instruction. To make up for the noninteractive nature of ITV, teachers should be trained to embed ITV in regular classroom instruction.

More programs that encourage the participation of the learner are being produced by local public television stations and by independent production concerns. Sesame Street and The Electric Company, both produced by the Children's Television Network, are familiar examples of this kind of programming. Teachers and instructional designers are also ddevising strategies for increasing more active viewing of ITV, strategies which are effective for learning, but do not require excessive preparation on the part of the teacher (Benning, 1986; Greenberg, 1984).

Flexibility of ITV

ITV programs have a variety of applications. They can stimulate discussion, motivate students to do additional research or reading, and illustrate abstract ideas and concepts. ITV can also provide students with information and resources that may not be available in their school or community.

Despite these advantages, ITV has limitations for flexibility. PBS and its affiliated public television stations set their ITV schedules on a yearly basis. Having to rely on a fixed broadcast schedule to receive ITV can limit a teacher's ability to use it. It is not always convenient or even possible for teachers to have their students in place at the time that a program is being broadcast. One solution to this problem is to air programs more than once.

Advances in videotaping and video storage provide another solution to the problem of a fixed broadcast schedule. Where they are available, videocassette recorders (VCRs) can be used to tape instructional programs at the time they are broadcast. Videocassettes make it possible to store the programs until they fit into a teacher's plans for the class. The cassettes can be reused for taping. They can also be stored in libraries at the school or at the district, regional, or state level.

ITV Programs

The development costs of ITV programs require that they be produced to serve the greatest number of students possible. Primary schools have the broadest needs and have been served well by ITV. Secondary schools, on the other hand, are departmentalized and offer more varied courses. The cost of developing programs for any one of these courses cannot be spread across as

many students as at the elementary level. Therefore, fewer programs have been developed for junior high and high school students.

Modern telecommunications technology, particularly satellite broadcasting, is making it possible to share single programs with wider audiences. These advances make it likely that the demand for secondary school programming will grow. The Corporation for Public Broadcasting (CPB) recently commissioned a market study to determine where the greatest demand for instructional programming is likely to be for the next five to ten years. Among the most promising market opportunities are science, social studies, and vocational and career education for junior and senior high school students (Cresap, McCormick and Paget, 1986).

A special advantage of instructional television over other technological tools in education (e.g., interactive videodisc or computer software) is the structure of the industry, which has developed the means for pooling expertise and scarce educational resources. In the last 25 years, several networks and cooperatives have been formed to coordinate the acquisition, production, and distribution of ITV programming. The Southern Educational Communications Association (SECA) is one of several regional ITV agencies in the U.S. The other regional ITV agencies are the Eastern Educational Network (EEN), the Central Educational Network (CEN), and the Pacific Mountain Network (PMN).

SECA and its regional counterparts coordinate cost-saving group buys of programs and equipment, contribute nonfederal financial support to boost CPB matching grants, and provide numerous staff development and professional growth opportunities to member stations. In conjunction with South Carolina ETV, SECA also coordinates the national ITV satellite schedule that feeds programming to local ETV-ITV stations.

This particular advantage of the ITV industry is demonstrated by the recently released ITV Futures study. The study was commissioned in 1984 by the Corporation for Public Broadcasting and prepared by the Pacific Mountain Network. ITV Futures: The Next Steps summarizes a variety of ongoing, coordinated efforts among ITV agencies and personnel across the U.S. to steer instructional television into the future of a more competitive technological environment. For the past two years, working groups and special projects have been organized to tackle issues related to funding, distribution, and quality control, among other things (Pacific Mountain Network, 1986). These efforts are bound to improve the quality and quantity of education services delivered via instructional television.

Summary

Instructional television is not a new distance learning technology. It is an educational tool that is already widely available, and it offers schools a means of providing learning activities for distant learners. The medium does have limits, particularly with respect to interaction and flexibility. However, these limits can be reduced by 1) thoughtfully integrating ITV with regular classroom instruction, 2) devising active viewing strategies, and 3) taping programs to be viewed when class schedules permit.

Before additional investments are made in telecommunications, the potential of ITV for distance learning should be carefully evaluated. The scarcity of educational resources makes it necessary for schools to maximize the potential of available resources. Regional ITV agencies, like the Southern Educational Communications Association, make it possible to pool human and

financial resources for the improvement of education in general and ITV in particular.

ITV Resources

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Section III. Extending Reach ... Satellite Broadcasting

The section on instructional television states that ITV must be delivered to classroom viewers using some kind of transmission hardware. Most viewers receive ITV on regular, open-circuit television channels. However, these channels have a limited transmission radius. For example, a single television signal cannot usually span an entire state. Satellites, on the other hand, make it possible to bridge such distances. They can even transmit from one side of the world to the other. This capability means that scarce resources can be shared with greater numbers of people. These resources include a wide variety of ITV programs, as well as instructors who can teach live over the satellite.

This section provides a brief discussion of how satellite technology operates. It also explores the use of satellites to transmit either taped or live instruction. Sample programs are described to illustrate the use of satellite for transmitting instruction either statewide or nationwide.

How Satellite Technology Operates

Schools do not purchase satellites; rather, they purchase a satellite transponder or lease time on a transponder. Each satellite has many transponders, or transmitters, on it. Leasing a transponder may be the wiser choice if a school system cannot make use of satellite broadcast capacity during enough hours of the day. On the other hand, if transponder time is going to be required 24 hours a day, then purchasing the transponder may be appropriate. The cost of either leasing or purchasing a transponder varies

with the kind of protection desired. Protection agreements typically cover maintenance and replacement of satellite transponders.

A satellite uplink is necessary to originate a broadcast. A license must be obtained from the FCC to operate an uplink. This device is used to transmit programs up to the satellite transponder, which in turn beams them back down to earth. The transmission signal is broadcast over the C- or Ku-band of the electromagnetic spectrum. Downlinks, or "receive only" satellite dishes, are needed to receive this signal. The higher the frequency of the signal, the smaller the dish required to receive it.

The Ku-band is at a higher frequency than the C-band. Besides being received by a smaller and therefore cheaper dish, Ku-band transmission eliminates terrestrial interference. C-band transmission, on the other hand, is sensitive to terrestrial interference. This is a phenomenon of densely populated areas that have a lot of activity in their spectrum space. Ku-band transmission is more sensitive to weather conditions and can be interrupted, for instance, by heavy rainfall. C-band transmission has been standard, but Ku-band transponders are becoming more common. An even higher frequency, Ka-band, is expected to be used in the future as available spectrum space in the Ku-band is taken up by growing numbers of commercial users.

Instruction delivered by satellite can either be taped, as in the case of ITV, or it can be live. These types of instruction are dealt with separately in the following segments of this section on satellite broadcasting.

ITV by Satellite

Satellite technology has proven especially useful for the national and regional distribution of instructional television. ITV is distributed by

satellite to public television stations at a fraction of the cost of mailing it and in much less time. As mentioned earlier, the Southern Educational Communications Association (SECA) is the regional ITV network that holds a contract jointly with South Carolina ETV to administer and distribute ITV nationwide by satellite. SECA develops the national schedule with input from the Firstview and SatScreen screening projects.

Firstview takes place in August and brings together ITV directors and media specialists to view new ITV programs. These personnel usually represent state departments of education and evaluate programs against state-mandated criteria. Selections are added to the programs aired on SatScreen.

SatScreen takes place in September and November and is viewed by teachers nationwide. Curriculum committee teachers participate from a local receive site. They are notified of the screening schedule and provided with supplementary guides to aid their viewing. Selections are based upon the needs of curricula and grade levels, as well as on participants' informal evaluations of program effectiveness.

The national ITV schedule includes PBS-sponsored programs, which are free to all viewing stations. The schedule is also used to distribute the most popular programs that were selected during SatScreen. These programs should be viewed only by the schools that have subscribed to them. Even so, anyone with a satellite dish can actually receive programs that are distributed by satellite. Schools with their own satellite dishes are becoming unwitting "pirates" when they tune in to programs that they have not paid to see. Technology is currently being developed that would enable satellite uplink operators to scramble their signal for all but legitimate subscribers.

Sample Programs

Alaska: From 1980 to 1986, the Alaska State Department of Education and the University of Alaska at Anchorage jointly sponsored the LearnAlaska Network. The network was funded by the legislature and operated through a partnership arrangement between the state department and the university. It served public school and university students in 250 communities across the state. The network operated 24 hours a day and 7 days a week. The C-band transponder, uplink, and downlink dishes were leased from AlasCom, the long-lines carrier for the state of Alaska.

Satellite technology was selected as the most efficient way to deliver instructional television to the many remote schools in Alaska. Alaska's geography requires that both telephone and television signals be transmitted via satellite. The state is so vast that the curvature of the earth's surface would interfere with a normal television signal. In addition, the cost of constructing repeater transmitters to relay a signal across the state would have been prohibitive.

Schools in many parts of the state are so small and remote that one teacher may be responsible for all students in grades 9-12 or K-12. Instructional television is a vital supplement to this teacher's efforts. For the most part, teachers taped programs off of the satellite and used them as their schedules would permit. The Office of Instructional Services developed resource materials for use with instructional television and selected the programs to air on the LearnAlaska Network.

It is uncertain at this time when or if the LearnAlaska Network will be regenerated. Falling oil prices have forced the LearnAlaska Network to shut down. Now the state department leases limited time on the satellite operated

by the state-wide entertainment network. Teachers can tape the few ITV programs that air late at night on this network. Occasionally time is freed up by the network for special programs to be aired during the day. Other programs must now be obtained through the state film library. The LearnAlaska Network is surely missed now that schools have to rely once again on limited broadcast time and the mail for the delivery of ITV.

For more information about the LearnAlaska Network, contact:

Bill Bramble
Administrator
Office of Instructional Services
Alaska State Department of Education
P. O. Box F
Juneau, AK 99811
(907) 465-2884

Kentucky: Beginning in the Fall of 1988, Kentucky Educational Television (KET) hopes to begin Ku-band broadcasting of ITV programs to Kentucky public schools. KET has a strong commitment to ITV programming for both Kentucky school children and adults. In addition to ITV for grades K-12, KET also offers a General Equivalency Diploma (GED) series, dropout prevention program, and other programs for adult learners. Some of this programming is offered as a public service, and some has been mandated by the state legislature.

The station has such an overabundance of ITV material that a second channel is required to distribute it all. However, an additional channel is not available in the state's spectrum space, and the cost of constructing the 15 UHF TV transmitters necessary to operate a second channel is prohibitive. In its search for an additional channel, KET discovered that a single satellite transponder can cover the same area as 15 UHF transmitters but at a lower cost.

An uplink operating facility will be used to broadcast programs to approximately 1700 buildings statewide, each of which will be equipped with downlink dishes. These buildings will include all of the Kentucky public schools, as well as the vocational education schools, public libraries, and county courthouses.

The station has not yet decided whether to lease time on or purchase a transponder. Its open-circuit broadcast facility will be reserved for programs that should be made available to the general public over regular television or cable. These programs include all shows for adult learners.

For more information about the KET satellite network, contact:

Paul Smith
Director
Technical Services
Kentucky Educational Television
600 Cooper Drive
Lexington, KY 40502
(606) 233-3000

Live Instruction by Satellite

When a school system cannot afford or attract a qualified teacher, live instruction by satellite is one option for expanding its teacher labor market. Satellite technology makes live communication possible between people on opposite sides of the country or opposite sides of the world. Teaching courses live by satellite is practical as long as there is enough student demand to justify the expense. The cost of the instructor is shared by other schools that cannot provide their students with traditional classroom instruction.

The instructor broadcasts at a regularly scheduled time either daily or a few days a week. Course materials are sent through the mail or by facsimile.

Students respond to the instructor by microphones that are linked to the satellite's audio-response channel or by long-distance phone lines.

Because the instructor cannot see his or her students, on-site coordinators are generally required to provide supervision during the class period and to manage the instruction locally. The responsibilities of on-site coordinators usually include motivating students and monitoring their progress, distributing materials, collecting homework, and proctoring tests.

Sample Programs

Oklahoma: In two more years, the Oklahoma State Department of Education will officially mandate two years of foreign language preparation for entrance into the state university system. Attempts to prepare college-bound students are already under way. Beginning in the spring of 1985, the Oklahoma State University Arts and Sciences Teleconferencing Service (ASTS) began offering German by satellite to 50 remote rural schools in Oklahoma. Since then enrollment has expanded into Arizona, Arkansas, Colorado, Kansas, Missouri, and Tennessee.

The program has also expanded to include physics by satellite. German and physics were selected for broadcast as the result of a survey of needs in Oklahoma schools. Based on additional needs, ASTS plans to uplink calculus and chemistry in the fall of 1987. Russian and Japanese courses are being developed for the fall of 1988.

The satellite courses are designed by the faculty members responsible for the live instruction. The programs are produced by OSU's Educational Television Service. Both the German and physics courses require on-site coordinators at each receiving school to motivate students and, in general, to

be responsible for local coordination of the course. The on-site language coordinator is not required to have any preparation in German or any other foreign language. The physics coordinator should be a math or science teacher with preparation in algebra and trigonometry.

German assignments are mailed to OSU where they are graded by graduate assistants. These assignments are then returned by mail. Physics assignments are graded by the physics coordinator based on detailed solutions provided by the satellite instructor. Final grades are assigned by the coordinator or a certified teacher based on the recommendations of either the German or physics instructor.

Courses are taught live for two periods a week. One class is kept on-line for the whole period and responds to questions in unison on a two-way speakerphone. Two additional long-distance lines are used to handle other students' questions during the class period. Three periods a week are set aside for drill and practice with software provided by the instructor. The instructor or an assistant can be contacted during office hours on a toll-free line. Questions can also be sent to the instructor by electronic mail.

In addition to the German and physics courses, ASTS also offers a series of live teleconferences on staff development for teachers and administrators.

For more information about the Arts and Sciences Teleconferencing Service, contact:

Bob Spurrier
Associate Director of Extension
or Ginny Pearson
Coordinator of Extension Programs
or Leigh Walters
Teleconference Coordinator
Arts and Science Extension
206 Life Sciences East
Stillwater, OK 74078
(405) 624-5647

Texas: TI-IN Network, Inc. is a private, for profit, satellite network that was developed to address the problems of teacher shortages and equal access to courses required for college admission. TI-IN provides Ku-band satellite capability, transponder time, and administrative coordination of course offerings and client schools. Instruction, accreditation, and training are provided by Texas state agencies, school districts, universities, and professional associations. The network operates six days a week from 6 am. to 10 pm.

TI-IN offers live instruction by master teachers in subjects that are difficult to staff. These subjects include algebra, trigonometry, computer math, physics, French, German, and Spanish. Staff development courses are offered to enable Texas teachers to advance on the state's career ladder. Enrichment programming is also provided by the network. Instruction was first broadcast to students in remote Texas schools in August 1985. Today, TI-IN's list of clients includes 2 Arkansas schools, 18 California schools, and 81 Texas schools.

For less than the cost of a single teacher, schools subscribing to TI-IN can receive up to 13 live courses on a daily basis. These courses are accredited by the state of Texas. Also included in the cost is most of the basic hardware needed to participate in the courses: lease and maintenance of the satellite receiving dish, toll-free telephone line and cordless phones for audio feedback, television set, videocassette recorder, and dot matrix printer. The printer is used to receive handout materials, tests, and assignments that are transmitted via satellite.

Enrollment in TI-IN classes is limited to 125 students nationwide for foreign language classes and 200 students per class in other subjects. These

limits are set by TI-IN to make the numbers of students manageable for the satellite teachers. If the demand is high enough, another teacher will be brought in to teach an additional section of the course. Classroom facilitators are designated in participating schools to take attendance, distribute class materials, and proctor tests. These facilitators include certified teachers, secretaries, and even parent volunteers. Completed assignments are mailed back to TI-IN to be graded by the satellite teacher.

For more information about TI-IN Network, contact:

Pat Tinsley
President
or Jo Babic
Operations Manager
TI-IN Network, Inc.
100 East Nasa Road 1
Webster, TX 77598
(713) 554-5545

Utah: Like Oklahoma, Utah will soon be instituting a 2-year foreign language requirement for entrance to its land-grant university system. Some private colleges will be instituting the same requirement. And, like several other states, Utah has many small and remote schools that cannot afford or attract foreign language teachers. Also at issue in Utah is the outcome of foreign language classes. The State Office of Education is not satisfied that students have in the past emerged from foreign language classes with adequate conversation skills.

With these issues in mind, the State Office of Education set out to develop a foreign language course that would emphasize practical speaking skills and be available to students in small, rural schools. The result was the Distance Accelerated Learning of Spanish Project. Spanish was selected as the foreign language for two reasons. First, Utah's largest minority is

Hispanic. Second, Spanish is one of five languages identified as being most important for living and working in the future world economy. The other four languages are Arabic, Chinese, Japanese, and Russian. Utah is already considering the development of a course in either Japanese or Russian.

Satellite technology is used to deliver the Spanish instruction. This technology suits the need to transmit the course to schools around Utah and across the country. This year, the Spanish class is being received by 3 Arkansas schools, 3 Colorado schools, 10 Georgia schools, 1 school in North Dakota, and 26 Utah Schools. Five New York schools are also receiving it on a pilot basis. Originally, the course aired live by satellite in the fall of 1985. Today, the instructor portion of the class is videotaped and aired on the satellite every other day. An independent evaluation prepared for the Office of Curriculum and Instruction concluded that live interaction during this portion of the class was not critical for student achievement. This finding, coupled with the difficulty of scheduling a live class for 48 schools in 3 time zones, led to the decision to videotape the instructor portion of the class.

On alternate days when they are not viewing the videotaped instructor, students work in groups on language games, or they work with software drill materials designed especially for this course. Assignments and tests are completed and graded on the computer. The only personnel required in the classroom are either a certified teacher or an aide. Knowledge of Spanish is not required for this person. Back in Utah, three certified Spanish teachers are available all day to answer students' questions via long-distance phone call. Eventually, a toll-free line will be established for these office hours.

For more information about the Distance Accelerated Learning of Spanish Project, contact:

Ken Neal
Coordinator
Information Technologies Unit
Office of Curriculum and Instruction
Utah State Office of Education
250 East 500 South
Salt Lake City, UT 84111
(801) 533-5573

Summary

Satellites make it possible to transmit either live or taped instruction over broad geographical areas. Generally, this means broadcasting statewide, regionally, or nationwide. Bridging these distances by satellite enables a school to expand its pool of educational resources. ITV is distributed by satellite in a more timely and cost-effective manner than by regular mail. Also, a single broadcast of ITV can be shared with a wider audience than a regular television broadcast can. Live instruction can also be shared with a wide audience via satellite. As long as programs are delivered to an adequate number of people, satellite broadcasting is a cost-effective means of providing distance education.

Interaction: Only audio interaction is possible during a live satellite telecourse. Video interaction is not possible. Students in remote sites can see the instructor, but the instructor cannot see them. This aspect of the telecourse is a disadvantage for the instructor and the students. On-site coordinators can be used to maintain control in the remote classrooms, but it is difficult for the teacher to develop more personal ties with remote students and vice versa.

Flexibility: Satellite technology is flexible insofar as it can be adapted for other uses besides classroom instruction. Live teleconferences by satellite make it possible to bring people together across great distances without the time and expense of travel. Additional uses of the technology help to defray its cost. Even so, scheduling live telecourses can be difficult as the number of receiving sites increases. Each school that subscribes to the telecourse may have unique scheduling problems. Differences in time zones may also complicate the problem further.

Satellite Programs: Satellite programs are being developed to provide instruction in subjects that are most difficult to staff, but problems related to accreditation arise when telecourses are broadcast across state lines. Courses cannot be tailored to meet the special needs of every state that subscribes to them. They are designed to meet accreditation standards in the state in which they are originated. Client states are responsible for seeing that these courses pass their own accreditation requirements.

Satellite Resources

Conversations with:

Jo Babic, Operations Manager, TI-IN Network, Inc. (Webster,TX)

William Bramble, Administrator, Office of Instructional Services, Alaska State Department of Education (Juneau, AK)

Elsie Brumbeck, Assistant State Superintendent, Media and Technology Services, North Carolina State Department of Public Instruction (Raleigh, NC)

Fred Daniel, Administrator, Planning and Information, Florida State Department of Education (Tallahassee, FL)

Peg Poley, Instructional Programming Specialist, Southern Educational Communications Association (Columbia, SC)

Robin Johnson, Finance Director, Southern Educational Communications Association (Columbia, SC)

Ginny Pearson, Coordinator of Extension Programs, Arts and Sciences Extension, Oklahoma State University (Stillwater, OK)

Paul Smith, Director of Technical Services, Kentucky Educational Television (Lexington, KY)

Robert Spurrier, Associate Director of Extension, Arts and Sciences Extension, Oklahoma State University (Stillwater, OK)

Section IV. Increasing Flexibility ... ITFS

Instructional Television Fixed Service (ITFS) is another means of transmitting both live and taped instruction to distant learners. The transmission range of ITFS is much less than that of a satellite, so ITFS transmission does not reach nearly as many people as a satellite does. However, this limit enables greater flexibility in scheduling and designing programs to meet specific needs. At the same time, the technology enables schools to expand their pool of educational resources. Even cooperative efforts between school districts make it possible for them to manage costs together, while maintaining a sense of local ownership.

This section provides a brief description of the history of this technology, as well as a discussion of how it operates. It also explores the use of ITFS to transmit either live or taped instruction. Sample programs are described to illustrate applications of ITFS to distance learning programs.

How ITFS Operates

ITFS refers to an area on the electromagnetic broadcast spectrum that is reserved by the FCC for the transmission of instructional and cultural material. It has been available for many years, but the high cost of equipment for transmission and reception of the low-frequency microwave signal in this range of the spectrum made the service prohibitively expensive for most educational institutions. The earliest applications of this technology were by hospitals and archdioceses in dense metropolitan areas. These organizations

used ITFS as a closed-circuit system for in-service training or across town conferencing.

Because the channels had been used so lightly for so long, the FCC released some of the original ITFS spectrum in 1970 and 1983 to commercial enterprises to create the Multi-Channel Multi-Point Distribution Service (MMDS). The FCC also stipulated that as long as a certain amount of instructional programming was transmitted over the ITFS system, the remaining hours could be used by commercial enterprises like cable TV companies. Arrangements with commercial operators can be used to defray the cost of operating an ITFS system.

As the market opened up to commercial users, the market for related equipment also began to expand. Today, the technology is more advanced and the costs associated with operating an ITFS system have decreased substantially, making it a viable technology for more educational institutions.

Currently, there are sixteen channels reserved for ITFS. These are allocated locally in blocks of four channels each. Multiple channels increase the amount of programming that can be transmitted simultaneously to receiving sites. By 1983, 88 ITFS systems were operating a total of 644 channels across the United States (Arnall, 1984).

Transmission is accomplished by a point-to-point, low-frequency microwave signal which has a 15- to 20-mile radius of coverage. Radius of coverage is increased by raising the height of the transmitting and receiving antennas or by constructing relay towers. This radius is also increased by using a more powerful transmitter. Downconverters at the specified receiving sites are necessary to convert the microwave signal to one that is compatible with

VHF/UHF television. This makes it possible to view programs transmitted by ITFS on a regular television set.

Just like satellite, ITFS is also used to transmit both ITV and live instruction. These options are dealt with separately in the following segments of this section.

ITV by ITFS

The primary use of ITFS in elementary and secondary schools is for the transmission of instructional television. Programs are transmitted for viewing during school hours and are also transmitted overnight for taping. Public television ITV schedules are determined on a yearly basis, but ITFS systems will typically budget some flexible time for week-by-week scheduling. This technology is an improvement over ETV transmission of ITV because of the additional services that it makes possible. Instead of general audience programming, ITFS has more nighttime hours in which to broadcast programs for taping, or air time can be made available to local cable companies in order to defray the costs of the system. The system can also be used for administrative conferences and for in-service training of teachers and other personnel.

Sample Programs

Florida: Even though Florida does not have a statewide ITV network, 87 percent of schools have television sets. The Department of Education develops an ITV catalogue based on a statewide screening and paper balloting process. Then the state purchases the duplication, distribution, and broadcast rights to the selected ITV programs. School districts send blank tapes to the ITV and Publications Division. In return, they receive taped copies of requested

programs. Each school district must decide for itself how best to distribute programs within districts. Already more than 100 ITFS licenses have been granted to Florida educational institutions by the FCC. Most of these are expected to be in use by 1987.

The Lee County (Fort Myers) School District has been distributing ITV by ITFS for the past ten years. Separate scheduling procedures are used for elementary and secondary schools. In the elementary schools, teachers are surveyed about the series they would like to use regularly. A master schedule is produced and summarized in a viewing guide. The elementary schedule is fixed, but each Wednesday is set aside for special requests. For now, ITV is distributed by ITFS to cable and then to the 10 Lee County elementary schools. The school district has discovered that some very desirable programs do not include cable broadcast rights. These programs can only be used on closed-circuit systems. For this reason, the elementary schools will eventually be outfitted with ITFS downconverters.

While one ITFS channel is used for primary school programs, two other channels are used for secondary school ITV. One of these channels distributes programming to middle school students, and the other is aimed at senior high students. The schedule on these two channels is completely flexible and can change from day to day. Teachers access a mainframe computer that houses the ITFS schedule. Programs are fit into available time slots and can be scheduled as much as 40 days in advance. The requested program will only come down off the system once. It is then taped for repeated use.

The ITFS system is also used for special live presentations like open school board meetings. These meetings are picked up by a local cable company

from the ITFS system and broadcast to viewers' homes. For those without cable reception, the high schools are open in the evenings to accommodate them.

For more information about the Lee County ITFS system, contact:

Southeastern Educational Improvement
Laboratory
P.O. Box 12746
Research Triangle Park, NC 27709
(919) 549-8216

South Carolina: In the fall of 1986, South Carolina Educational Television (SCETV) started a system of ITFS networks to replace their old closed-circuit networks. From 1960-1986, SCETV leased a microwave and cable system network from Southern Bell of South Carolina. The phone company subsidized the cost of operation and provided broadcast facilities. This closed-circuit network was used to deliver ITV to secondary schools.

The cost of leasing the cable network became prohibitive when Southern Bell was forced to increase the amount charged to SCETV. In addition, future expansion of the network would have been prohibited by the cost of laying down new cables. Replacement with ITFS is expected to provide schools with more flexible service at considerable savings over the cost of the old network.

In the short run, the ITFS network consists of 14 local area transmitters (LATs) and 12 wide area transmitters (WATs) with 6 relay stations. The LATs are fed by 14 tape and delay centers. Each of these centers has a library of materials approved by the state department of education. School district personnel work with local secondary and vocational education schools to develop a local ITV schedule.

Eventually, an additional 24 LATs will be constructed to increase local coverage of the ITFS network. In the meantime, schools not within range of an

LAT can receive ITV programs from one of the WATs. The WATs receive programming from the state microwave system. This microwave signal originates from SCETV in Columbia. During the day, these schools receive ITV on two channels of the WAT. The only disadvantage to these schools is that the WAT schedule is set by the state. Nevertheless, most of the schools have VCRs to record programs that air at inconvenient times.

In the evening, all four WAT channels are used to provide continuing education to hospitals, colleges, and law enforcement personnel.

For more information about the SCETV ITFS networks, contact:

John M. Lawson
Director
Public Information
South Carolina ETV Network
P.O. Drawer L
Columbia, SC 29250
(803) 737-3233

Live Instruction by ITFS

Live instruction transmitted by ITFS is more commonly used by postsecondary institutions in their distance learning efforts. Nevertheless, some secondary schools already have experience with this application of the technology, and other programs are now being developed. The ITFS signal enables one-way video and two-way audio interaction. The teacher is visible to students at each of the remote sites. An audio response channel replaces the telephone for pupil-instructor exchanges. Just as for satellite telecourses, on-site personnel are needed to monitor students' behavior and to distribute and collect assignments. Two-way video interaction, enabling the teacher to see remote students, is possible by adding either a full motion video signal (e.g., low power television or microwave) or freeze-frame television.

Sample Programs

Minnesota: The Eagle Bend Communicasting System links five school districts in central Minnesota by ITFS and low power television (LPTV). These school districts are too small to offer many electives to their secondary students. Offering elective courses via telecommunications enables the schools to provide instruction without moving students or teachers around. The Communicasting System also makes it possible for these schools to tap into resources in the other communities without having to consolidate.

Eagle Bend serves as the control point for the system, which also serves students in Clarissa, Bertha-Hewitt, Parkers Prairie, and Staples Public Schools. Courses offered include advanced mathematics, shorthand, physics, Spanish, and German. These are taught by teachers in each of the school systems. Because each town has the capability to originate a microwave signal, instruction can be originated from any of the participating communities. Instruction is transmitted by microwave from the originating school to the control point in Eagle Bend. From here it is transmitted via LPTV to the four other schools involved. ITFS is used to bring full motion video of students in the remote sites back to the teacher. The teacher can see two classrooms at a time. A technician in Eagle Bend handles the switching from one pair of classes to another to allow the teacher to keep an eye on remote students.

The only time someone is required to be in the classroom is during a test. At this time, the principal or another certified teacher proctors the students. If there is a need for shorter turnaround time, papers are sent back and forth using facsimile machines. Otherwise, assignments are mailed back to the teacher or picked up by a cooperative bus that travels regularly between the participating communities. All work is graded by the teacher.

Low power television technology enables the entire community to watch the Communicasting classes from their homes. When the school day is done, the ITFS equipment goes down, but the LPTV is used for public television programs and for C-span coverage of House proceedings.

For more information about the Eagle Bend Communicasting System, contact:

Russ Martinson
Superintendent
Eagle Bend High School
P.O. Box 299
Eagle Bend, MN 56446
(218) 738-6442

New York: In 1985, the New York State Board of Regents adopted the Regents' Action Plan. This educational reform package legislated increased graduation requirements in social studies, foreign language, math and science. Three school districts within the area served by the St. Lawrence-Lewis Board of Cooperative Educational Services (BOCES) decided to pool their resources in order to provide the required courses to students in their communities.

These school districts are located in the northwest Adirondacks. Each of them was experiencing increasing education costs, declining enrollments, and a declining rural tax base. Among the solutions to their joint problem was either consolidation or teacher and student exchanges. None of these were attractive options. Instead, the school districts decided to take a closer look at the kind of solutions technology could offer them. They discovered that a two-way (audio and full motion video) ITFS system could be a cost-effective alternative to moving students and teachers around.

In the fall of 1985, the Interactive Instructional Telecommunications System ("I.T.") began to serve students and administrators at the St. Lawrence-Lewis BOCES and the Edwards, Gouverneur, and Harrisville Central School

Districts. Start-up construction costs were paid by a legislative grant. Subsequent operating costs are shared by the school districts and the BOCES. The schools developed a common seven-period schedule. Courses taught live over the "I.T." system include health, shorthand, psychology/sociology, Spanish, business law, AP English, and AP math.

At least two courses are originated from each of the three schools involved. In this way, school districts can share their teachers. A microwave repeater tower is located between the three schools to relay the ITFS signal from the originating classroom to the remote receiving classrooms. Each classroom is equipped with a color TV camera, a live microphone, a viewing monitor for students in remote classrooms, and two television sets that enable the teacher to see students in the remote classrooms.

Students can not only see and hear their instructor, but they can also see, hear, and speak to students in either of the other classrooms. Assignments are transmitted back and forth from students to teachers by facsimile machines. Bulkier materials, like books, are delivered by a courier system van that shuttles between the school districts three times a day.

Sub-channels of the ITFS system also make it possible for the school districts to share library resources and computer data. Some additional applications of the "I.T." system include teacher conferences, in-service training in cooperation with local colleges, and joint board meetings.

For more information about the Interactive Instructional Telecommunications System, contact:

Elizabeth A. Durocher
Director
Learning Resource Center
St. Lawrence-Lewis BOCES
Northeast Campus
P.O. Box 310
Norwood, NY 13668
(315) 353-6693

Summary

The previous section noted that satellites are advantageous for reaching a wide audience of people at one time. The audience for programs transmitted by ITFS is much smaller. However, the specific needs of a smaller audience are easier to accommodate. The broadcast range of ITFS is wide enough that contiguous communities can share resources to address common needs.

Interaction: An audio-response channel enables two-way audio interaction when teaching live over an ITFS system. Two-way video interaction is possible by sending either a full motion video signal (e.g., low power television or microwave) or still images (e.g., freeze-frame television) of remote classrooms back to the instructor.

Flexibility: ITFS offers greater flexibility in the local delivery of ITV because of the multiple channels available in each system. Special programming requests are more easily accommodated when several programs can be offered at the same time. The technology is also adaptable for use in staff development or administrative conferences.

Programs: ITFS is a closed-circuit system. Courses are designed to meet the special needs of the schools that have access to the system. At the same time,

participating schools or school districts contribute resources in such a way as to expand the pool of resources available to all.

ITFS Resources

Arnall, Gail. Instructional Television Fixed Service: An Analysis of ITFS Operations. Washington, DC: Corporation for Public Broadcasting, [April 1984]. (To obtain, send $5.00 to CPB, 1111 16th Street NW, Washington DC 20036)

Kessler, Gehman and Associates, Inc. Instructional Television Fixed Service Guidebook: A Primer on ITFS. Columbia, SC: Southern Educational Communications Association, [1983]. (To obtain, call SECA at (803) 799-5517)

Conversations with:

Lawrence Behr, Broadcast and Telecommunications Consultant, Lawrence Behr Associates, Inc. (Greenville, NC)

Bonnie Bettinger, Superintendent, Gouverneur Central Schools (Gouverneur, NY)

Carol Bosley, Telecourse Coordinator, Adult Learner Television, WVIZ (Cleveland,OH)

Elizabeth A. Durocher, Director, Learning Resource Center, St. Lawrence-Lewis Board of Cooperative Educational Services (Norwood, NY)

Clyde Green, Director, Office of Instructional Technology, South Carolina State Department of Education (Columbia, SC)

Russ Martinson, Superintendent, Eagle Bend Public Schools (Eagle Bend, MN)

Marie Noska, Communicasting Coordinator, Eagle Bend Public Schools (Eagle Bend, MN)

Tim Osborne, Instructional Television Consultant, Lee County Public Schools (Fort Myers, FL)

F. Sam Ulmer, Director, Systems Planning and Development, South Carolina Educational Television (Columbia, SC)

Joe Vapenik, Chief Field Engineer, WVIZ (Cleveland,OH)

Section V. Containing Costs ... Audio-Teleconferencing

The preceding sections dealt with two different media used to deliver video instruction, live or taped, into the classroom. Satellites make it possible to reach wide audiences, while ITFS makes it possible to tailor programs and schedules to address the special needs of a limited audience. Despite their advantages, however, these technologies are still very expensive for most schools, even if cooperative ventures are possible. For this reason, most live interactive distance learning takes place by audio-teleconference using standard telephone technology. Low costs and the limited expertise required to operate the technology account for its popularity.

This section briefly describes the operation of an audio-teleconference. Sample programs are included to illustrate the application of this technology to distance learning.

How an Audio-Teleconference Operates

Any site around the world that is equipped with a telephone can participate in an audio-teleconference. Multiple sites can be connected through a dedicated network or by a teleconference bridge.

A dedicated network is built by the phone company to connect sites that communicate often. Dedicated lines are permanently reserved for this purpose and can only be used to contact other sites connected by the same dedicated network. Picking up a phone at one of these sites automatically connects the caller with the other sites. Usually no dialing is necessary. Because the

lines are reserved 24 hours a day, a dedicated network is more expensive to operate than a teleconference bridge.

Using a teleconference bridge, there are several ways to connect audio-teleconference participants. All bridges have a certain number of ports at which to connect calls. "Meet-me" bridges require teleconference participants to call into the bridge. An operator connects them to ports on the bridge at this time. To connect participants to a "dial-out" bridge, the operator must have all of their phone numbers ahead of time. When the teleconference is scheduled to begin, the operator calls each of the participants to connect them to reserved ports on the bridge. It is also possible for these procedures to be automated, instead of relying on an operator's assistance.

Audio interaction alone can be an effective tool for distance education, but will not, of course, serve to illustrate visual concepts. The following technologies are often used to augment instruction by audio-teleconference. These technologies are also connected by telephone line to participating sites.

Electronic Blackboard: The electronic blackboard is a pressure-sensitive device that is used very much like a regular blackboard. The instructor produces an image, like a diagram or an equation, on the board's surface. This image is transmitted through a telephone line, decoded at the receiving site, and displayed on a monitor for students in the remote classroom. The image produced at the receiving end is about 98 percent identical to what the instructor has actually written on the originating blackboard.

Freeze-Frame Television: Freeze-frame television works much like an electronic slide projector. A television camera is connected to a freeze-frame transceiver that is used to capture a still image and convert it for transmission through a telephone line. This image is reprocessed by a second

freeze-frame transceiver at the receiving site and viewed on a regular television set. Images of medium resolution can be produced every 36 seconds. Higher resolutions take longer to produce. Freeze-frame TV is used to transmit photographs, pictures of the instructor and students in remote classrooms, and other visual materials. These materials can be exchanged between classrooms as long as each site is equipped with a television camera, scan converter, and television set.

Facsimile: Facsimile machines are already used to transmit printed materials from one office to another. Today, the technology is being applied to the problem of quickly sending printed materials like tests or handouts to students in remote classrooms. A scanning light codes information that is fed into it, sends it through the telephone line, and decodes it when received by another facsimile machine.

Sample Programs

North Carolina: North Carolina's Basic Education Plan stipulates that all students are entitled to education of equal quality. Rural schools with low enrollments and teacher shortages are finding it difficult to offer their students the same variety of courses offered in larger schools. The Downeast Instructional Telecommunications Network (DITN) uses audio-teleconferencing technology to address this problem in two rural school districts in eastern North Carolina.

DITN is coordinated by the Rural Education Institute in the School of Education at East Carolina University. The project was established in 1985 with a federal grant through the Carl Perkins Vocational Education Act. During the 1985-86 academic year, five schools in the Hyde County and Beaufort County

school districts participated in a physics class by audio-teleconference. The program has since expanded to include a sixth school, as well as a course on the principles of technology.

A 12-port teleconference bridge, owned by the network, connects the six remote sites. Each classroom is equipped with computers, a printer, an electronic blackboard and a receiving monitor, a speaker, microphones, and a modem. The modem is used to connect the classroom to the audio-teleconference bridge. All of the computers in the six schools are linked together in a network so that information can be shared among them. The printer can be used to make a hard copy of any data transmitted on the electronic blackboard.

Because each participating site has both an electronic blackboard and a receiving monitor for the blackboard, the instructor can originate lessons from any of the remote classrooms. For now, the origination site is rotated on a daily basis. Eventually, the instructor plans to spend a week at a time teaching from each classroom.

A facilitator is designated for each remote site. A few of the facilitators are certified to teach the course themselves. However, low enrollments mean that their schools cannot afford to pay them to teach it. Instead, they participate in the class by monitoring student behavior, proctoring tests, and performing experiments described by the instructor. The instructor picks up and delivers assignments and does all of the grading for the course. Occasionally, assignments are completed and graded on the computer network.

For more information about the Downeast Instructional Telecommunications Network, contact:

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Wisconsin: During the 1970s, Wisconsin Cooperative Educational Service Agency (CESA) #4 experienced a decline in student enrollment. Hardest hit by this decline were foreign language classes. Alternative ways of getting foreign language instruction to students in CESA #4's school districts had to be explored. Audio-teleconferencing was found to be an affordable option. In 1979, the CESA Teleconferencing Network (CTN) was established using a Title IV-C federal grant. The network links 46 sites in 40 school districts within 180 miles of LaCrosse, Wisconsin.

CTN is coordinated through Instructional Communications Systems (ICS), a department of the University of Wisconsin-Extension in Madison, Wisconsin. ICS is responsible for designing the network, training teachers and other educators to use it, and technical coordination of the network itself. Four-wire dedicated telephone lines connect the audio-teleconferencing sites together. These are leased 24 hours a day from the phone company. Microphones and conference phones are owned by CTN.

CTN is responsible for the programming that is delivered over the network. All teachers are certified to teach a foreign language. The courses they teach include German, Spanish, and French for grades 9-12. Some enrichment programming is provided for the lower grades. CTN hopes to provide instruction in Japanese to Grades 5-7 beginning in January 1987. Also offered after school

hours are remedial courses in English or social studies for students who still need credit to graduate.

Each remote classroom is equipped with a conference phone which carries the teacher's voice. Students can interrupt at any time to ask a question by activating their microphones. There is, on average, one microphone for every two students in a class. Teachers do not have formal office hours, but they are available over the network before and after class. Formal instruction comes over the network for only 45 minutes a day to allow more time for questions outside of class and to accommodate the variety of schedules in participating schools.

The presence of an adult is required in each remote classroom, because the instructor cannot see the students to monitor their behavior. Depending on the school, this adult might be the principal, a certified teacher, an aide, or a librarian. Besides monitoring classroom behavior, these on-site coordinators also hand out materials and proctor tests. Assignments and tests are delivered to and picked up from school sites by a CESA van twice a week.

Instruction can be originated from any of the participating classrooms, so teachers try to visit each of the remote sites at least twice a year -- once in the fall and again in the spring. This practice enables students to have some face-to-face contact with their instructor. A get-together is held once a year to bring all of the students in a course together to meet one another.

For more information about the CESA Teleconferencing Network, contact:

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Summary

Audio-teleconferencing provides an inexpensive means of expanding curriculum offerings. At the same time, this technology is familiar and easy to use.

Interaction: Audio-teleconferences do not use two-way full motion video. Audio interaction alone cannot illustrate visual concepts, so various audio-graphic devices, like electronic blackboards and freeze-frame television, are used to augment the medium.

Flexibility: Any site that is equipped with a phone can participate in an audio-teleconference. The technology is flexible enough to be used for either enrichment programming or for regular classroom instruction. The same technology can also be used for administrative conferences.

Programs: Some educators feel that audio-teleconferencing alone is boring to students. Others insist that the technology is not being used creatively if students are bored. In either case, it is important to involve students in lessons by continually asking questions or soliciting comments from them. Audio-only instruction should be delivered in short blocks and followed by question-and-answer segments. Electronic blackboard and freeze-frame TV images can add to the interest a lesson has by giving students something to see, but they do not add greatly to the cost of an audio-teleconference.

Audio-Teleconferencing Resources

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Conversations with:

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Cynthia Keen, Marketing Manager, Colorado Video, Inc. (Boulder, CO)

David McIntosh, Teleconferencing Specialist, Colorado Video, Inc. (Boulder, CO)

Virginia Ostendorf, Teletraining Consultant, Virginia A. Ostendorf, Inc. (Littleton, CO)

James Shaeffer, Coordinator of Teleconferencing, University of Wyoming (Laramie, WY)

Weldon Sleight, former Director, Life Span Learning, Utah State University (Logan, UT)

Section VI. Getting Started

Telecommunications-based distance learning is all about expanding resources. Instructional television brings new places and experiences into the classroom. Live telecourses or teleconferences enable students to interact with and learn from experts and students in other communities. Telecommunications cannot replace regular classroom instruction, but experience demonstrates that distance education is a viable alternative when traditional classroom teachers are not available.

Schools with scarce resources should heed the experience of educators who have already begun to work out some of the problems of providing instruction through distance learning media. A suggested strategy for getting started includes:

- Clearly define needs for curriculum expansion. Establish whether or not these needs are peculiar to local schools, districts, or regions. Or perhaps these needs characterize the entire state. Be aware of opportunities to share resources with those who have similar needs.
- In addition to the need for curriculum expansion, school systems also have administrative needs that could be served well by the application of the technologies discussed in this report. These needs should be identified and integrated into plans for the design of distance education projects. Or, at the least, projects should be designed with the idea of expanding in the future to incorporate administrative needs.
- Before investing in more technology, assess the distance learning potential of technology that is already available -- instructional television, for example.
- Utilize educators' experience, the literature, and other resources. Explore the technology that seems most likely to address the needs specified in your school(s).

- Identify teachers who are willing and able to teach via telecommunications. Teachers do not necessarily have to adopt different teaching styles to accommodate distance media. Instead, they should capitalize on strategies that make them effective in face-to-face classroom situations. The most important skill for the distant teacher to cultivate is the ability to encourage students' participation.

- Assemble the necessary expertise ...
  Legal: to provide assistance if filing an FCC license application for technologies that operate within regulated spectrum space.
  Engineering: to custom design a system configuration for the locations in question and provide an estimate of the cost.
  Financial: to research state funding formulas, grant resources available for distance learning projects, or cooperative ventures with business and industry.
  Instructional Design: to match curriculum objectives with the medium selected for delivery of distance education.
  Teacher Training: to provide distance teachers and local staff with adequate preparation to teach effectively using the technology and to handle contingencies of the technology.

- If you do not have the necessary experts on staff, then secure the services of a consultant with varied experience in the field of telecommunications.